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ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

Overwintering Habits of *Ips lecontei* Sw. and *Ips confusus* (Lec.)

in Arizona and New Mexico

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Ips lecontei Sw., the Arizona five-spined engraver, is a bark beetle pest of ponderosa pine in central and southern Arizona. Out-

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breaks, frequent on the Prescott National Forest, have caused severe tree mortality in the pole stands (fig. 1). *Ips confusus* (Lec.), the California five-spined engraver, is a common pest of pinyon pine in Arizona and New Mexico. Outbreaks of this bark beetle have been widespread, causing extensive tree mortality in relatively short periods (fig. 2). Outbreaks of these two bark beetles are especial-

Figure 1.--Ponderosa pine killed by *Ips lecontei*, Prescott Ranger District, Prescott National Forest, Arizona.

Figure 2.--Pinyon pine killed by *Ips confusus*, Bandelier National Monument, New Mexico.



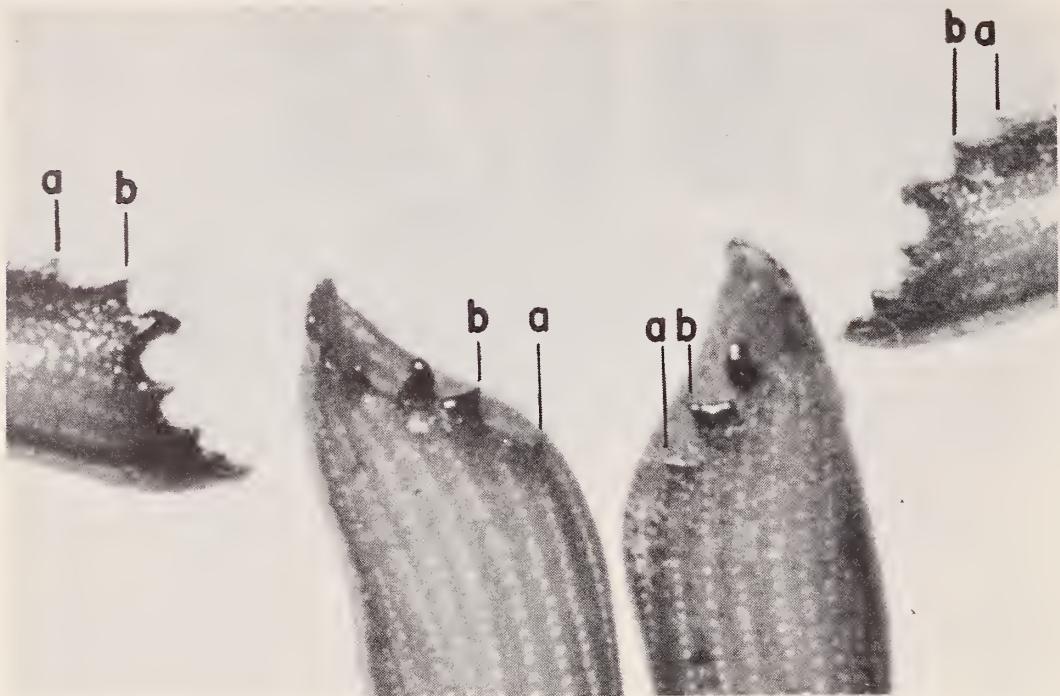


Figure 3.--Elytral declivity from *Ips lecontei* on left and *I. confusus* on right. Note that the distance between the first tooth (a) and second tooth (b) is 1.5 to 2 times greater on *I. lecontei*.

ly serious when they occur around homesites, and in National Parks, Monuments, and other areas of high recreational use.

The two species are similar in size, and have five teeth on each side of the elytral declivity. The species can be separated by the arrangement of the first and second teeth in reference to the declivital suture. *I. confusus* has the first declivital tooth nearly equidistant from the declivital suture and the second tooth. The first declivital tooth of *I. lecontei* is closer to the declivital suture, which results in a relatively large space between the first and second tooth (fig. 3).

Development from the egg to the adult stage is rapid between April and October. Usually three and sometimes four generations are produced by each species during this period, which leaves little time between attack periods to evaluate or control infestations. November through March (when the insects hibernate) is therefore the most favorable time to evaluate and control outbreaks. The overwintering habits of these beetles were studied to aid development of evaluation and control procedures.

The overwintering adults of both species commonly feed in colonies in portions of the inner bark not eaten by the larvae or associated insects (fig. 4). In many pinyon trees, colonies of *Ips confusus* were so numerous and large that the feeding chambers coalesced

and lost their individual identity. In ponderosa pine, each colony of *Ips lecontei* was served by one entrance hole and usually contained 25 to 150 members. The colonies are apparently established during the fall, when adults emerge from pupal cells in other portions of the same tree or other trees.

OVERWINTERING STAGE OF DEVELOPMENT

Data were collected during the winter months of 1960-61 and 1961-62. During these years both *I. lecontei* and *I. confusus* overwintered as adults in standing trees. Most of the individuals in the last generation reached the adult stage by November. However, some were adults by October in 1961; all by December of that year (table 1).

BROOD DENSITIES AND DISTRIBUTION IN THE HOST

Three to seven infested trees of each species were felled each month, and the infested portion of the bole was cut into 12-inch lengths. The infested portion of the felled tree was determined by spot checks along the bole. Bolts were cut between ground level and 25 feet. Seven ponderosa pines were sampled between 15 and 40 feet. The 12-inch bolts were marked as to tree and height above the ground, and then transported to the laboratory for

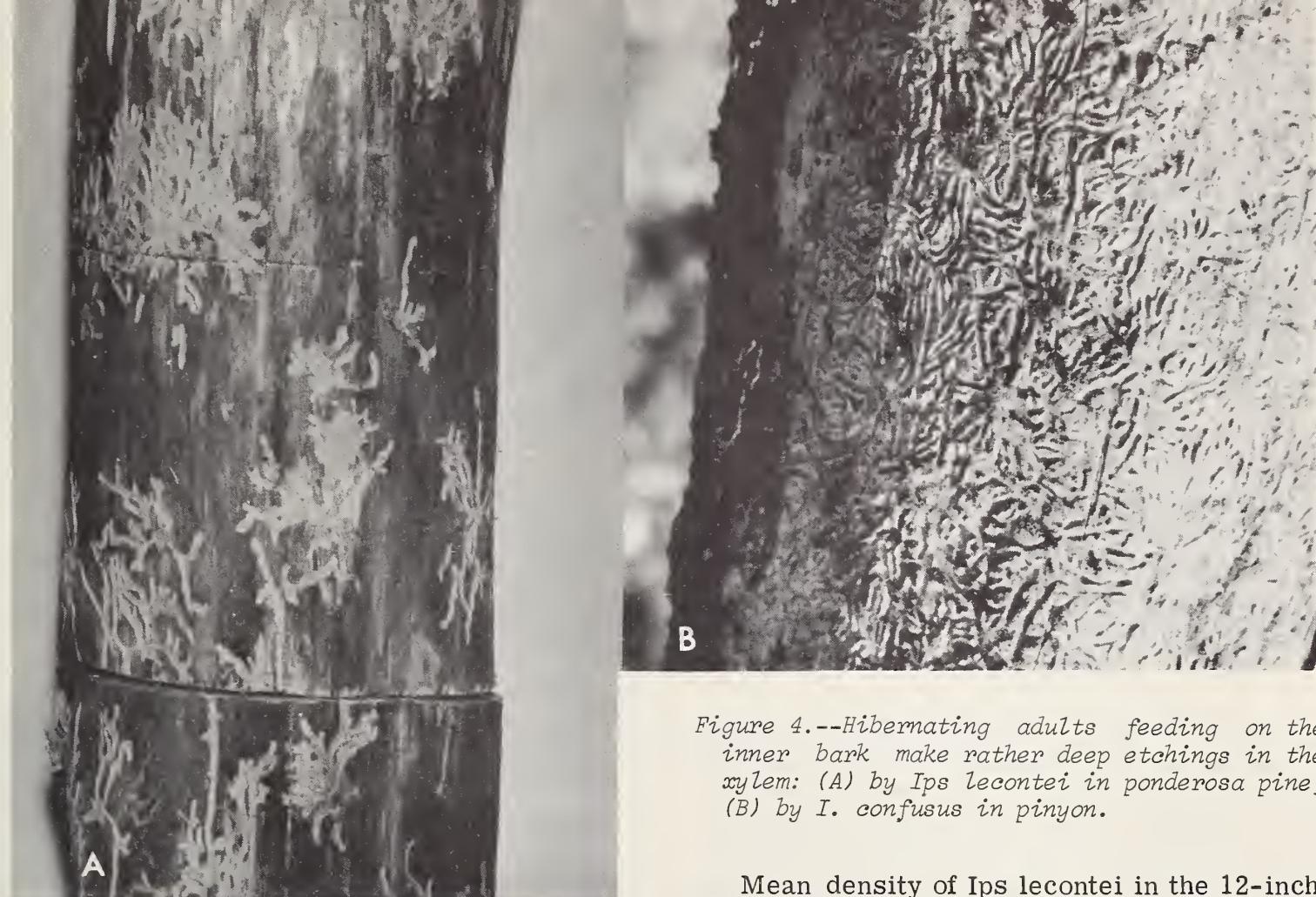


Figure 4.--Hibernating adults feeding on the inner bark make rather deep etchings in the xylem: (A) by *Ips lecontei* in ponderosa pine, (B) by *I. confusus* in pinyon.

examination. In the laboratory, the bark was removed from each bolt, and the brood density was determined. A total of 43 ponderosa and 29 pinyon pines were examined.

Mean density of *Ips lecontei* in the 12-inch sections taken at 1 and 2 feet, 4 and 5 feet, and 9 and 10 feet above the ground (table 2) reveal that brood densities vary considerably at any given height above the ground, even in trees in the same diameter class. In the smallest trees examined, density was greatest at ground level and decreased with height.

Table 1.--Percentage of living insects in the larval, pupal, and adult stages of *Ips lecontei* and *Ips confusus* in standing trees, 1960-61 and 1961-62

Sample date	<i>Ips lecontei</i>						<i>Ips confusus</i>					
	1960-61			1961-62			1960-61			1961-62		
	Larvae	Pupae	Adults	Larvae	Pupae	Adults	Larvae	Pupae	Adults	Larvae	Pupae	Adults
October	--	--	--	0.2	0.7	99.1	--	--	--	5.4	4.0	90.6
November	8.9	8.1	83.0	0.0	.6	99.4	0.0	0.1	99.9	.1	.5	99.4
December	1.4	.6	98.0	0.0	0.0	100.0	0.0	.1	99.9	0.0	0.0	100.0
January	0.0	.6	99.4	--	--	--	0.0	0.0	100.0	--	--	--
February	0.0	0.0	100.0	0.0	0.0	100.0	--	--	--	--	--	--

Table 2.--Mean density of overwintering adults in standing pines as determined from 12-inch sections at three heights on the main stem

Sample height above ground (Feet)	Ips lecontei in standing ponderosa pine								Ips confusus in standing pinyon pine									
	1-5 inches d.b.h.		6-8 inches d.b.h.		9+ inches d.b.h.		1-5 inches d.b.h.		6-8 inches d.b.h.		9+ inches d.b.h.		1-5 inches d.b.h.		6-8 inches d.b.h.		9+ inches d.b.h.	
	Average per sq. ft. of bark	Percent of samples infested	Average per sq. ft. of bark	Percent of samples infested	Average per sq. ft. of bark	Percent of samples infested	Average per sq. ft. of bark	Percent of samples infested	Average per sq. ft. of bark	Percent of samples infested	Average per sq. ft. of bark	Percent of samples infested	Average per sq. ft. of bark	Percent of samples infested	Average per sq. ft. of bark	Percent of samples infested		
1 and 2	74	±23	89	109	±19	70	9	± 3	25	178	±34	100	314	±47	100	419	±66	100
4 and 5	75	±11	100	129	±14	93	30	±26	54	149	±14	100	222	±30	100	270	±19	100
9 and 10	28	± 6	100	101	±14	100	47	±14	60	105	±27	100	143	±42	100	226	±39	100

In the average-size trees (fig. 5), density was relatively low at the base of the tree, increased at varying rates to a maximum density between 5 and 10 feet above ground level, and then gradually decreased with height. The height of maximum densities varied extremely in large trees, but usually occurred between 10 and 30 feet above ground level.

The distribution pattern of Ips lecontei (table 2) shows the percent of samples infested increases with a decrease in diameter of the host. These data indicate that the distribution of the hibernating adults is a function of diameter rather than height. Ostmark² found this same relationship in the brood density of the spring and summer generations.

Mean density of Ips confusus at three heights in three size classes of pinyon pine (table 2) shows densities vary greatly at the three heights, even in the same diameter class, and brood density decreases with diameter within trees and apparently between trees. Generally, density dropped gradually from a maximum at or near ground level to a relatively low number at the top of the main stem (fig. 5). The greatest density per 12-inch section was found within the first 5 feet on 86 percent of the 29 pinyons examined, and within the first foot on 55 percent.

SUMMARY AND CONCLUSIONS

Ips lecontei is a serious pest of ponderosa pine in Arizona, while Ips confusus is a seri-

² Ostmark, H. E. *Life history and habits of the Arizona five-spined engraver, Ips lecontei. A progress report of studies in 1959-1960. Rocky Mountain Forest and Range Expt. Sta., Fort Collins, Colorado, 21 pp.* (Typewritten)

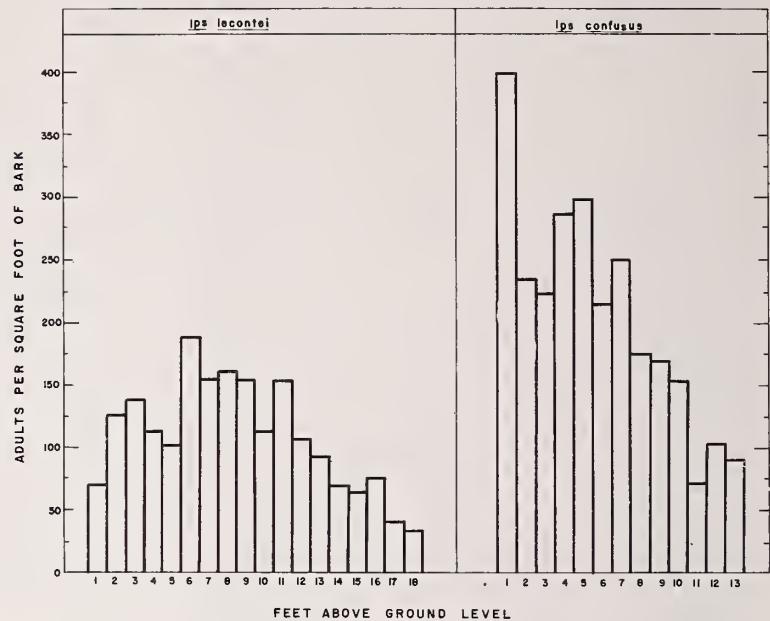


Figure 5.--Brood density per square foot of bark, as determined by complete examination of an infested stem at 1-foot intervals, illustrates the typical distribution pattern of *I. lecontei* in ponderosa pine and *I. confusus* in pinyon pine. The trees are 7 inches in diameter at 5 feet above the ground.

ous pest of pinyon pine in New Mexico and Arizona. The two species closely resemble each other morphologically, but they can be readily separated by the spatial arrangement of the first and second declivital teeth. Most of the hibernating beetles of the two species reach adulthood by October, congregate in colonies, and construct feeding galleries in which they pass the winter. The large number and distribution of these colonies result in high brood densities with large variances per unit of bark surface. Hibernating adults of Ips lecontei were found more frequently in stems under 9 inches in diameter than in stems over 9 inches in diameter; densities varied with diameters. Hibernating adults of Ips confusus were consistently present in the largest portions of the infested tree; densities were generally highest at or near ground level and decreased with tree height.